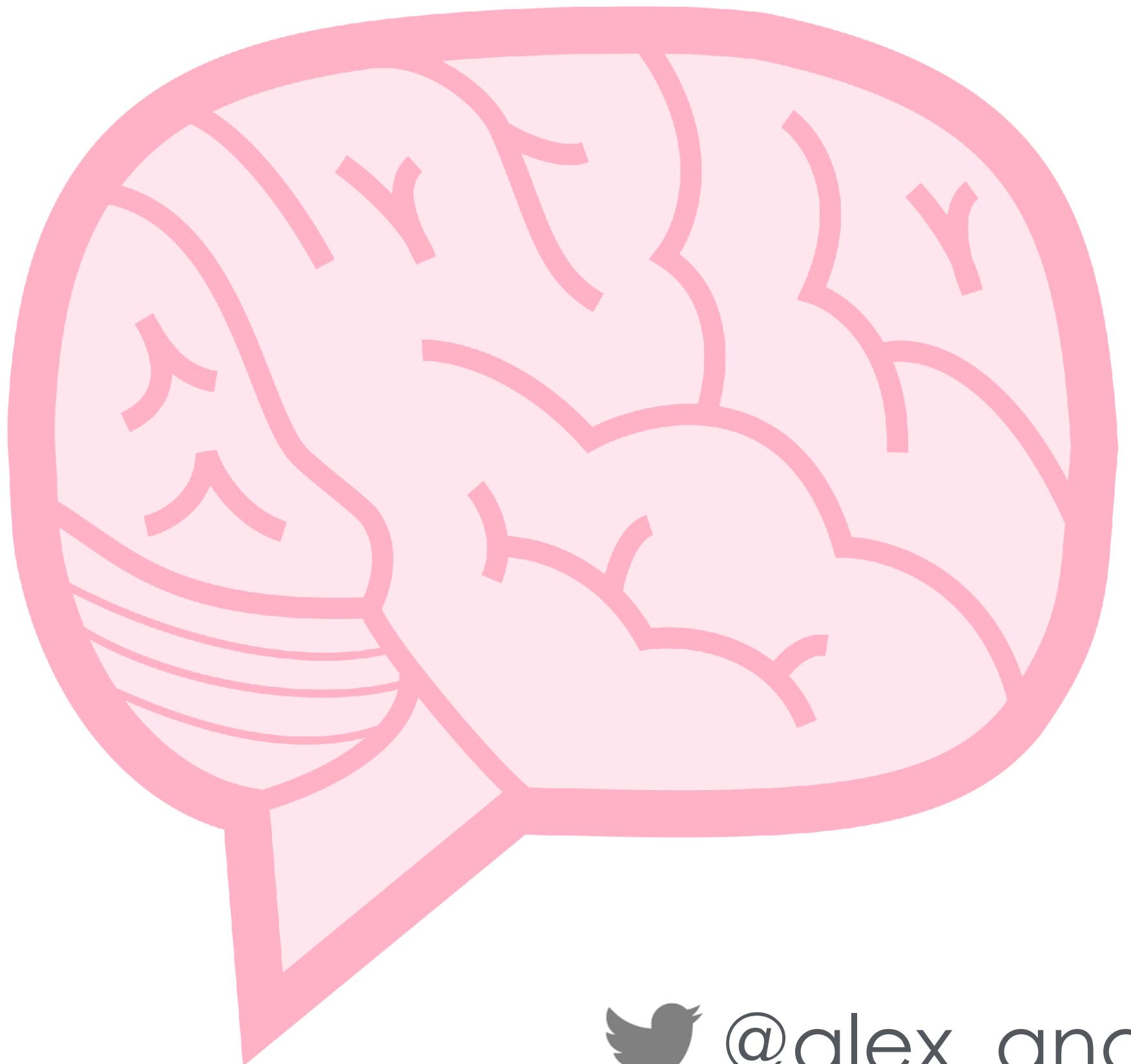


MAPPING LANGUAGE MEANING IN THE HUMAN CORTEX

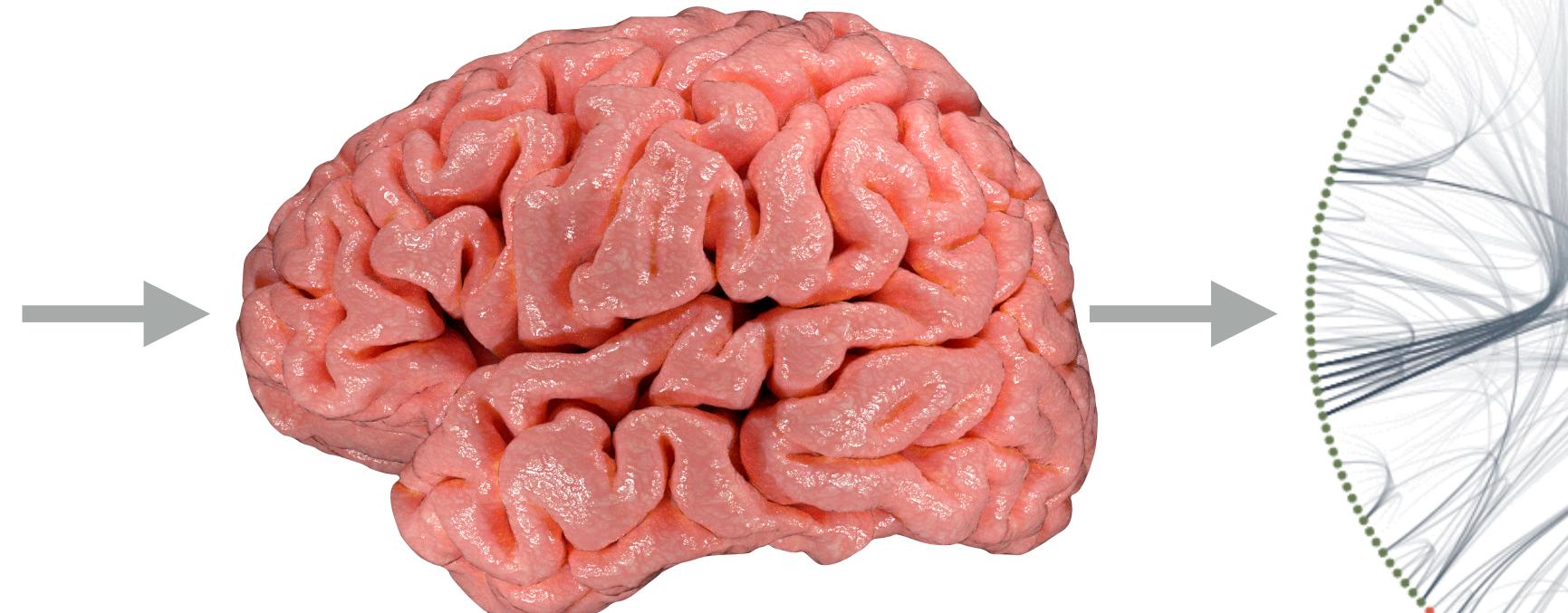
Alexander Huth
The University of Texas at Austin
Computer Science & Neuroscience
7.29.2020



 @alex_ander

HOW DO WE UNDERSTAND LANGUAGE?

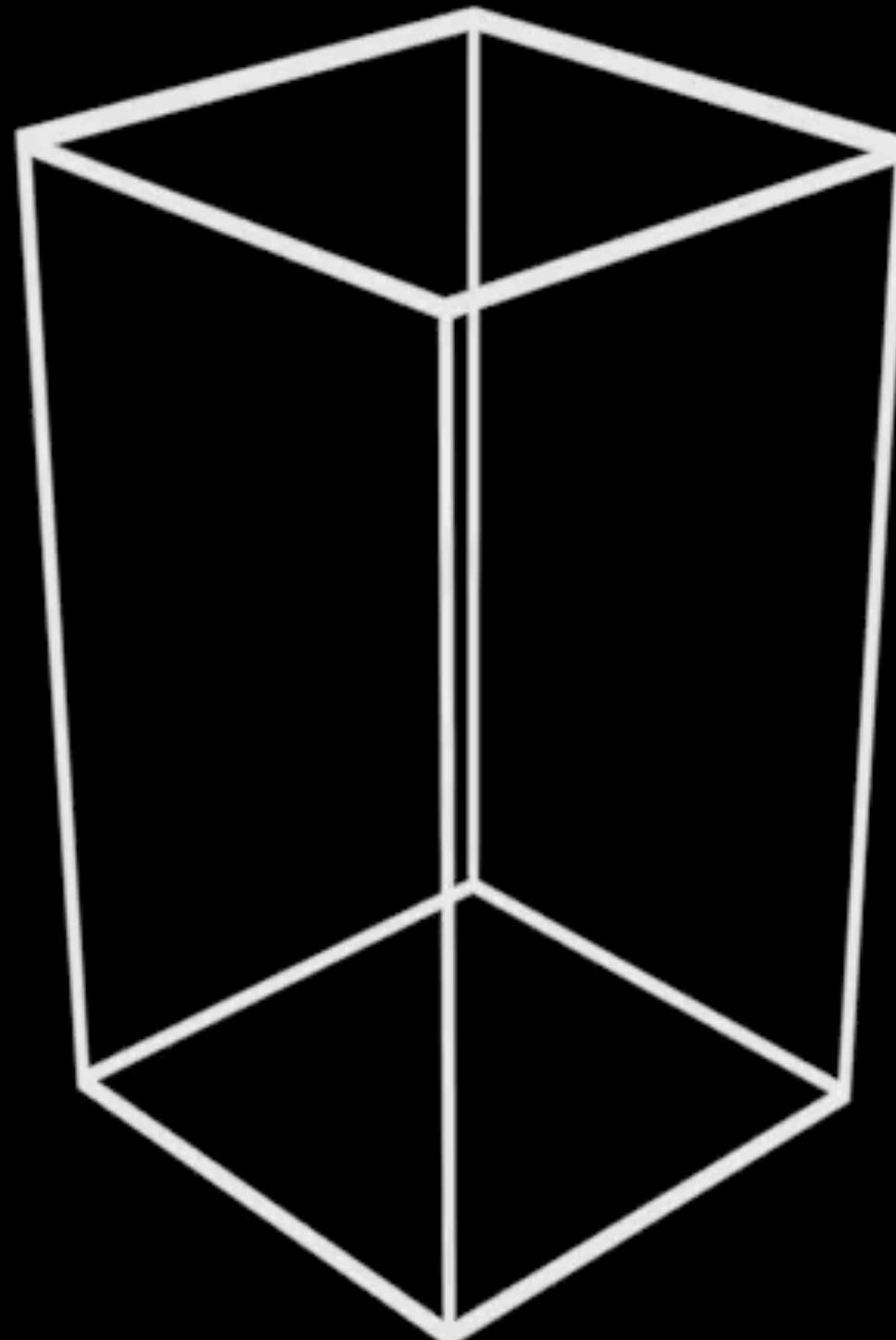
*“Close your eyes
and let the word
paint a thousand
pictures...”*



© Thomas Lin Pedersen



A SINGLE VOXEL



2.24mm

2.24mm

4.1mm

$R(t)$ response over time



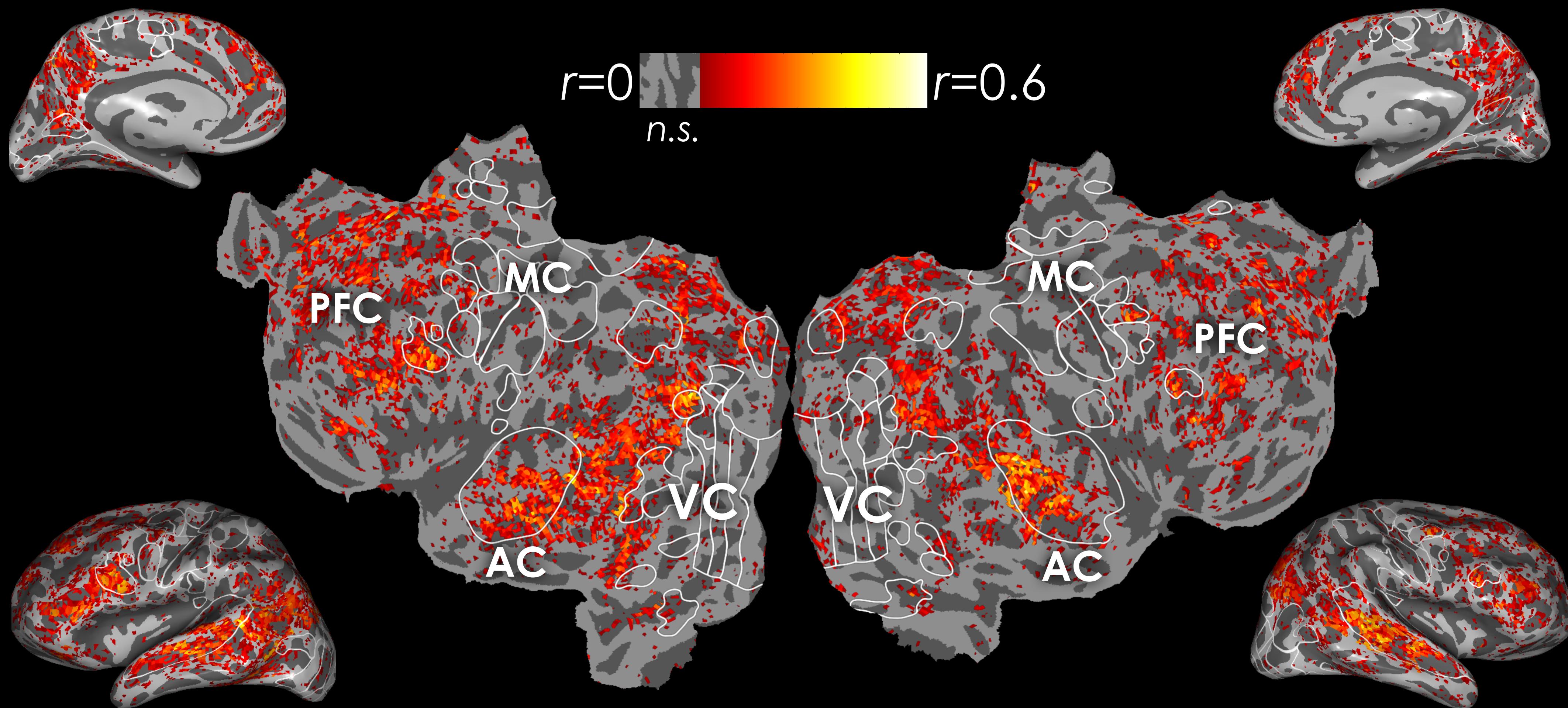
WORD MODEL

SIMPLE WORD MODEL:

each voxel responds (some amount) to each word

$$R(t) = \sum_{i=0}^N \beta_i W_i(t)$$

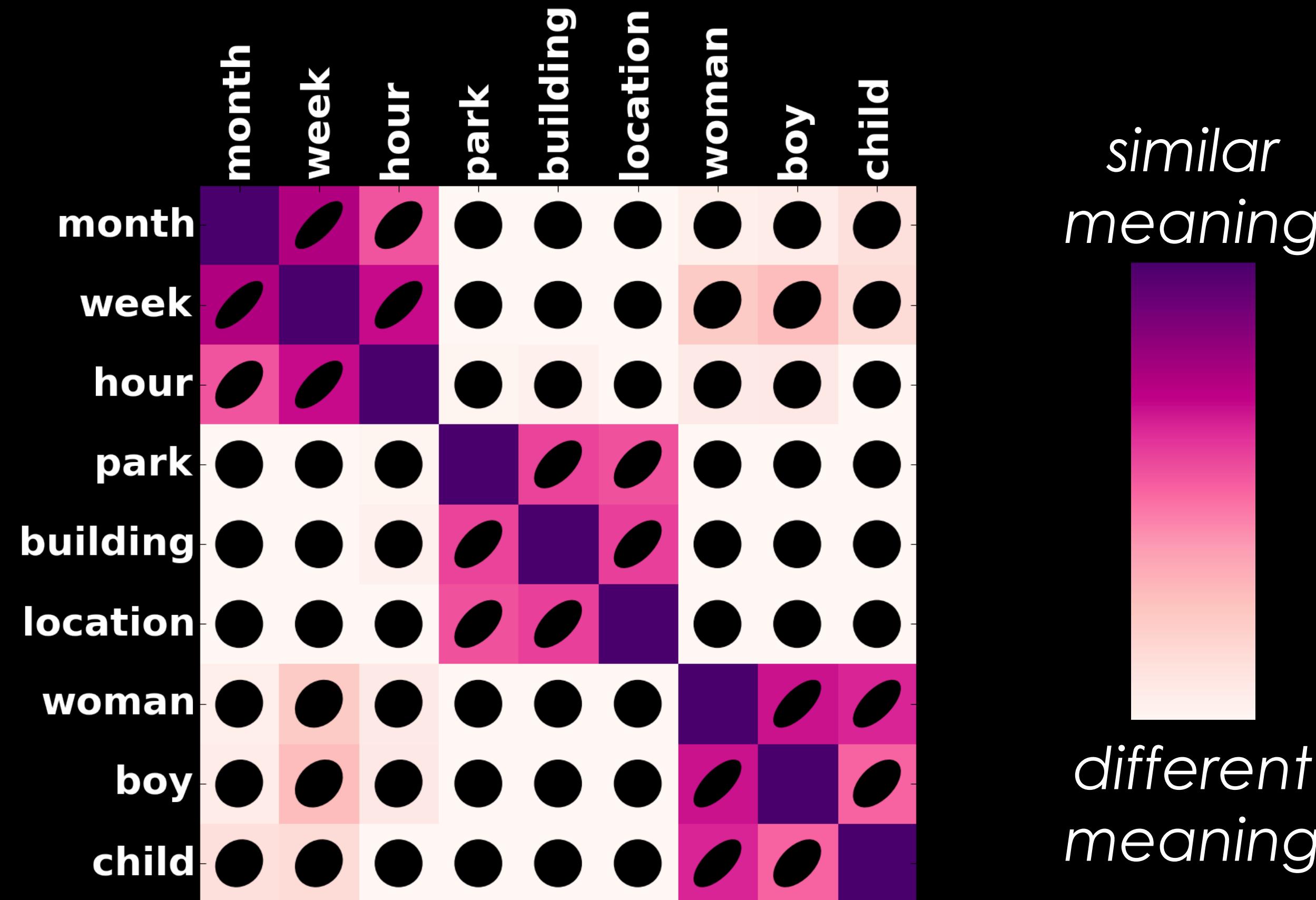
WORD MODEL PERFORMANCE: MEDIOCRE



SEMANTIC MODEL

IMPROVED MODEL:

similar responses to words with similar meanings



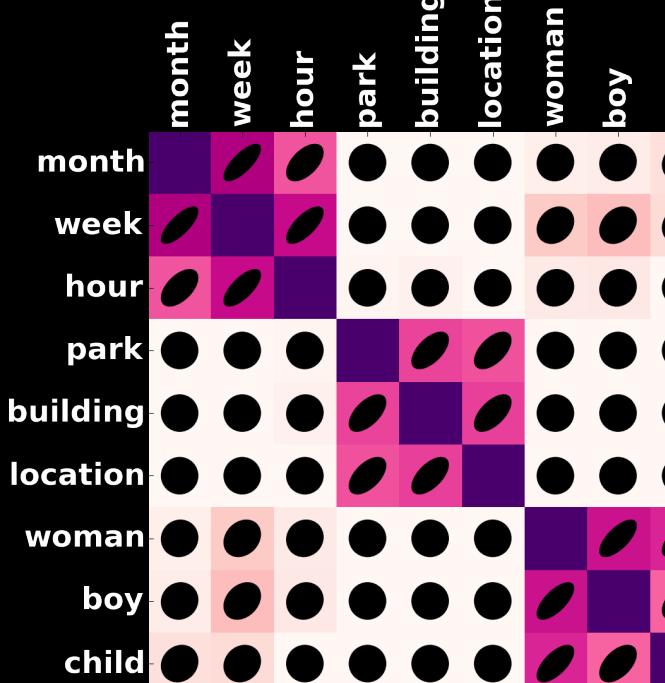
SEMANTIC PRIOR

IMPROVED WORD MODEL:

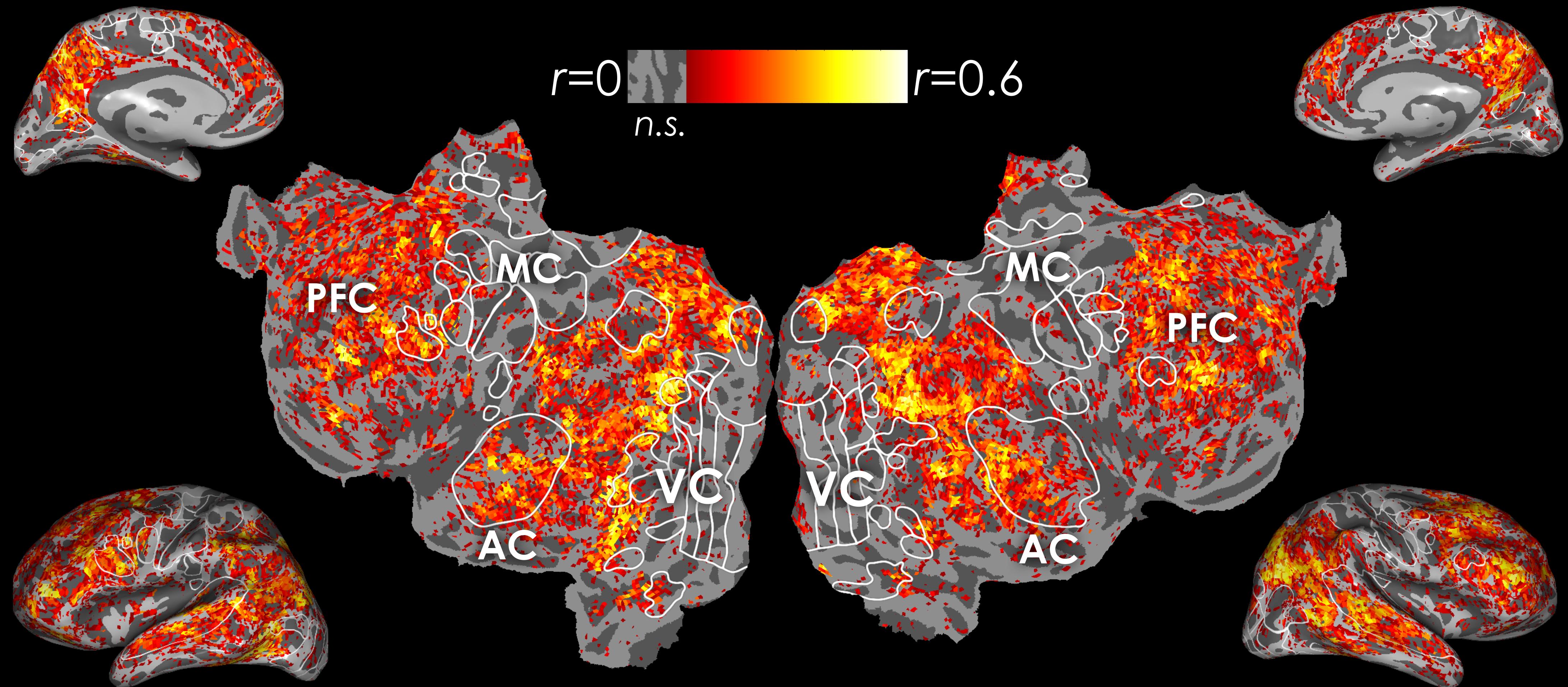
similar responses to words with similar meanings

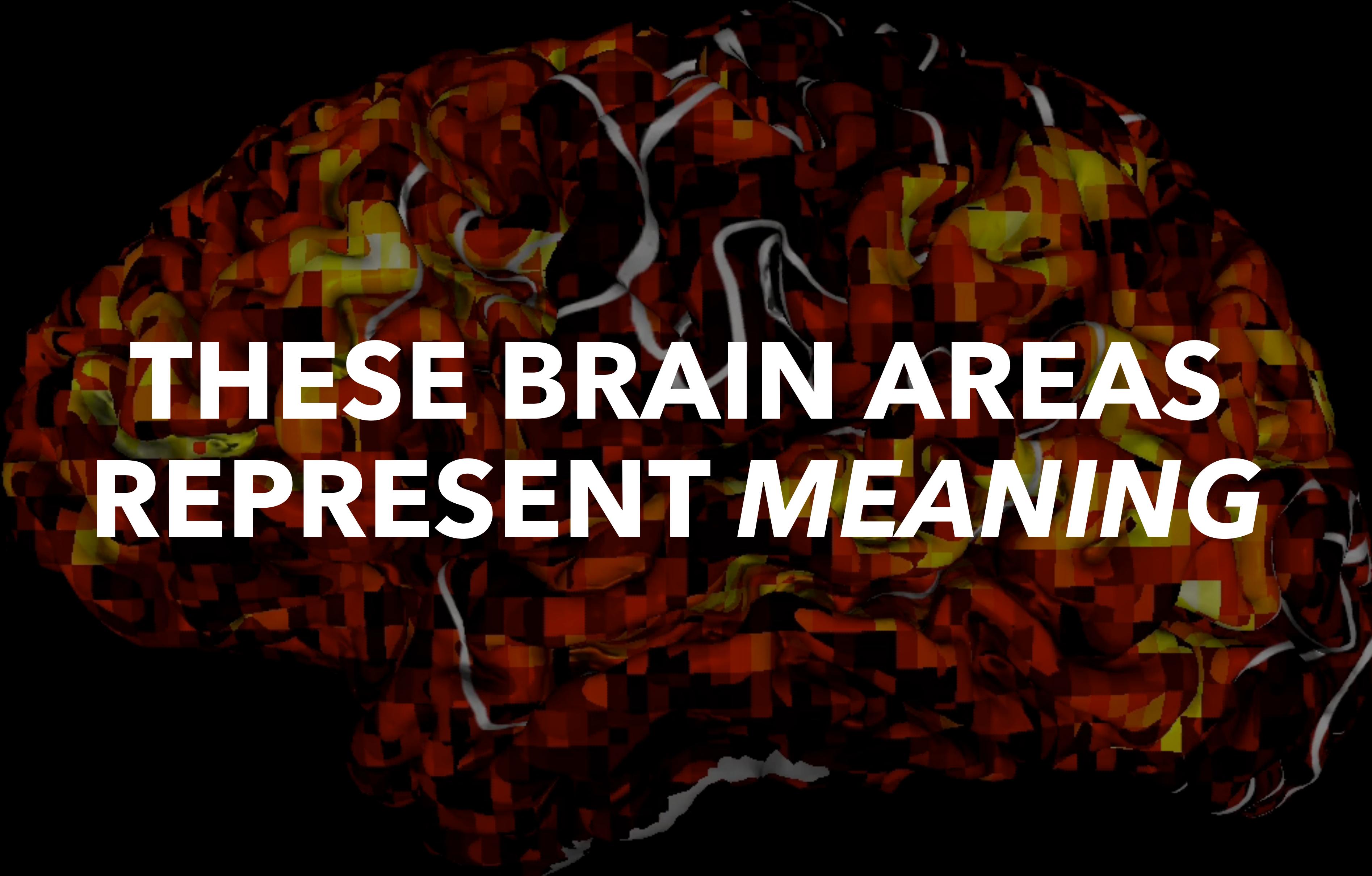
$$\hat{\beta} = \operatorname{argmax}_{\beta} P(R|\beta, W)P(\beta)$$

likelihood prior



SEMANTIC MODEL PERFORMANCE: EXCELLENT





**THESE BRAIN AREAS
REPRESENT MEANING**

TODAY'S TUTORIAL

Topics:

1. What is **regression**? How does it work?
2. Regularized (**ridge**) regression
3. Structured **Tikhonov regularization** using word embedding vectors